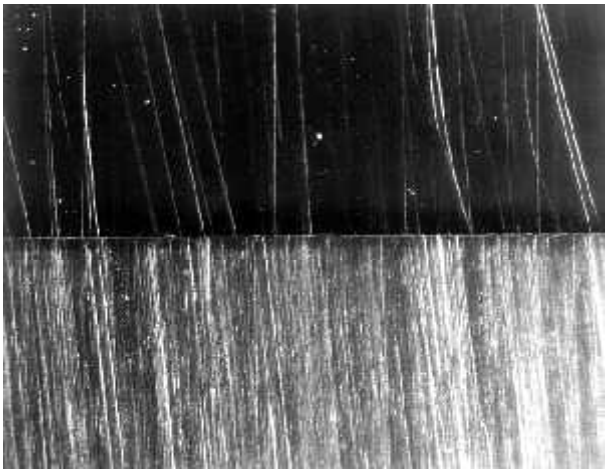
Protective, Abrasion-Resistant Coatings With Tailorable Properties

Because of their light weight and impact resistance, transparent plastic structures are becoming increasingly desirable for use not only on aircraft but also in terrestrial applications such as automotive windshields and ophthalmic lenses. However, plastics are typically soft and scratch readily, reducing their transparency with use. At the NASA Lewis Research Center, reactively deposited aluminum oxide coatings as thin as 12,000 angstroms have been demonstrated to provide improved resistance to most scratches encountered during normal use. The properties of the coating can be adjusted to tailor the surface to meet other needs, such as water shedding. These adjustments can be made during the deposition process so that multiple manufacturing steps are eliminated.

In this reactive deposition, aluminum oxide is sputter deposited from an aluminum target simultaneous with the direction of an atomic oxygen plasma on the surface that is being coated. The aluminum combines with the atomic oxygen at the surface to form a very hard aluminum oxide coating that is under less compressive stress than a coating sputter-deposited from an aluminum oxide target, and this reactively deposited coating can be grown thicker without spalling. Addition of other materials, such as fluoropolymers, during the deposition process can reduce the intrinsic stress of the coating even further. Reactively deposited aluminum oxide is slightly more hydrophobic (water shedding) than sputter-deposited aluminum oxide, and it can be made hydrophilic (water retaining) with the addition of fluoropolymers. It also is very transparent. An approximately 12,000-angstrom-thick coating reactively deposited on polycarbonate increases the absolute absorptance by only 1.8 percent. At this thickness, the coating can resist abrasion by small particles that would be present when windows, optical lenses, or other surfaces are cleaned.



Polycarbonate with top half coated with reactively deposited aluminum oxide. Surface was abraded with house dust.

The abrasion resistance and transparency of reactively deposited aluminum oxide makes it

attractive for a broad range of applications where lightweight and transparent plastics could be effectively used. In addition, the ability to add other materials during the deposition process allows the potential for tailoring the coating to meet the needs of specific use environments.